already seen, that here its SOLVENT as well as attractive properties are exerted and employed. In galvanism, the excitation of this power, I repeat, depends on the alternate arrangement of dissimilar metals having a fluid interposed between them, for which the one metal has a greater affinity than the other, so that chemical changes are the consequence: the fluid is decomposed, and the products assume the gaseous form; a demand is made on this grand agent, in order to dissolve and support these new forms of existence, which are thus produced*. In this way the metal in contact becomes robbed of its natural quantity, and demands a fresh supply, which is no sooner received than it is imparted to the metal having the stronger affinity for the fluid, and where these changes and gaseous results require and demand it. Thus a current is produced alternately positive and negative; but which differs from electricity not only in the retardation these actions occasion, but in having to traverse a different medium—an imperfect conducting fluid, by which the current has its velocity not only further retarded and broken, but its qualities modified.

All that has been now laid down will be further confirmed by the views we shall develop when we come to Chemical Affinity, Light, and Electricity; when I trust I shall satisfy the reader that I have not in the commencement held out more than I shall be able to establish, as I proceed in executing the task. Still, I trust every allowance will be made for any imperfections which must necessarily be connected with the novelty of the views, on so extensive and so difficult a subject as that of not merely marking effects and phænomena, but the mode of operation and nature of that power which produces them.

Colliergate, York, July 15, 1818.

[To be continued.]

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## XIX. *Observations relating to the Operations undertaken to determine the Figure of the Earth. By M.* BIOT, *of the French Academy of Sciences* †.

WHEN about two centuries ago Galileo, on one of the towers of Florence, explained to a few individuals, in language almost mysterious, his new discoveries respecting the laws of gravitation, the motion of the earth, and the figure of the planets; how little did he imagine that these truths, at that time so miscon-

* It has been often explained how this power in different quantities, differing in every different kind of matter, produces and sustains bodies in all their various forms, states, and stages of existence.

† From the French of M. Biot.

ceived and so persecuted, would, after so short an interval, be deemed of such importance and so generally admired, as to induce the governments of Europe to undertake great operations and distant voyages for the sole purpose of explaining them, and of verifying all their relations; and that, by the effect of an unexpected propagation of knowledge, the results of these labours should be presented to the attention of the public in numerous assemblies composed of the most eminent classes of society! Yet such is the great change which has been effected in the fate of the sciences since that period.

When Galileo and Bacon appeared, they found the sciences only on the brink of being—for it would be inaccurate to give the name of science to that mass of useless hypothetical speculation of which all natural philosophy previously consisted. The aim of the ancients was rather to divine than to investigate natural causes. The art of examining nature in order to constrain her to reveal her secrets was unknown;—it remained for Galileo and Bacon to make this discovery. They evinced that the human mind is too feeble, and too evanescent in its efforts, to advance by its own strength through the labyrinth of natural facts; that it is necessary at every new step of its progress to rest upon and to classify those phænomena which approximate to one another; and that in the multiplied opportunities which nature offers for inquiry, experiments industriously imagined are requisite to conduct to a course of new phænomena which shall neither entangle nor mislead.

Such has been the felicity of this mode of investigation, that in less than two centuries, discoveries without number, and certain and durable, have illustrated every department of science;—the arts have rapidly participated in their beneficial effects; industry has been enriched with many wonderful applications, and a sum of knowledge has been accumulated a thousand times greater than that of which antiquity could ever boast. As the sciences, however, have thus been enlarged, they have grown beyond the reach of any single individual to attain. So large a sphere could no longer be embraced but by a numerous literary body, which in its aggregate capacity similar to one mind should unite all conceptions, views and thoughts; and which, interrupted neither by human infirmities nor the decline of reason, or age, but always young and always vigorous, should incessantly scrutinize the peculiar properties of natural objects, discover the powers concealed in them, and at last present them to society prepared and ready for application. In a central body such as this, where opinions have the freest operation, no authority can prevail, if it be not that of reason and of nature. The voice even of a Plato himself could no longer gain attention in such

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an assembly to the brilliant reveries of his imagination ; and the genius of a Descartes would be constrained faithfully to adhere to that mode of observation and of doubt which he himself had promulgated, and not pretend to exhibit truth unmixed with error : nor with all their glory could Plato and Descartes be now regarded as more than mere elementary branches of this great organ of the sciences :—its force would outlive their genius, and carry into futurity the gradual development of their thoughts. —Such is now the noble, destiny of learned societies. The simultaneousness and the durability which their institution gives to the efforts of mortals, complete the power of the experimental method. They alone can in future give continuity to the progress of knowledge; they alone can develop grand theories, and produce results which, by their difficulty, by their diversity, by the perseverance and the extent of exertion which they require, could never be attained by individuals.

To determine the size and figure of the earth ; to measure the gravity at the surface, to ascertain its connexion with the interior construction, with the disposition of the strata, and the laws of their densities, are of the number of those important questions which learned societies alone could resolve. During a century and a half they have formed a chief object of the Academy of Sciences. The first exact measurement of a degree of the terrestrial meridian was made in France by Picard in 1670. Newton availed himself of it, in order to establish the law of universal gravity. Richer, who was sent by the Academy to Cayenne, two years after, to make astronomical researches, discovered that his clock, which at Paris beat the seconds, went gradually more slowly as he approached the equator ; and that it again went quicker, by the same degrees, in returning towards the north, so as to resume exactly its original motion at the point of his departure. Again, according to the discoveries of Huygens, the quickness of the oscillations of a pendulum augments or diminishes with the intensity of the gravity which causes its motion. His observation proved that this intensity was different in different latitudes, and that it increased in going from the equator to the pole. Newton in his Principles of Natural Philosophy connected all these results with the law of attraction. He showed that the variation observed in gravity disclosed a flattening of the earth at the poles; a circumstance which is also observable in the form of Jupiter, Saturn, and the other planets which turn upon an axis. He conceived that this flattened form was a consequence of the even attraction of the portions of every planet, combined by the centrifugal force of its rotatory motion. But in order that the arrangement determined by these two kinds of forces should thus have been able to make itself effectual,

fectual, it behoved these great bodies to have been originally fluid. He took them then as in that state, and showed how to calculate the flattening of a planet, according to the intensity of the gravity at its surface and the quickness of its rotation, supposing its mass to be homogeneous. This theory, applied to the earth, gave a variation of gravity but little different from that observed by Richer, though somewhat slighter, indicating that the earth is composed of strata of which the density goes on increasing from the surface to the centre, as Clairault has since demonstrated.

For some time the calculations of Newton were the only inductions for believing the earth to be flattened at the poles. The arc of the meridian measured by Picard was sufficient to give the length of the semidiameter of the earth at the place where it was observed; but that arc was much too small even for showing imperfectly the effect of the flattening. More accurate knowledge was expected to be procured from the measurement of the complete arc which traverses France from Perpignan to Dunkirk, which was intended to serve as the axis of a general map of France, with the execution of which Colbert had intrusted the Academy. But in the imperfect state of the instruments and astronomical methods of that period, this arc itself was too short to make the influence of the flattening distinctly perceptible; and the small variations which thence result in the length of the consecutive degrees, might very easily be lost in the errors of the observations, as was indeed actually the case. The differences which the degrees presented, were found from the effects of these errors, in such a direction as would have led to the result of elongation at the poles, in place of flattening. The Academy was not intimidated. It perceived that the question could not be accurately decided without measuring two arcs of the meridian, the one near the equator and the other near the pole. In the year 1735, Bouguer, Godin, and La Condamine were sent to America, where they joined the Spanish commissioners. Clairault, Maupertuis and Le Monnier departed for the North. The results of these expeditions completely ascertained the flattening of the earth, but its absolute amount still remained uncertain. The degree of Peru compared with that of France, gave a slighter flattening than if the earth was homogeneous; the sphere of Lapland indicated a greater. In this uncertainty the lengths of the pendulum which they were careful to measure, agreed with the flattening deduced from the operation at the equator; but the exactness of these measurements, especially in the sphere of Lapland, was not such as could enable them to solve the difficulty.

Matters remained in this state for fifty years. Meanwhile Bouguer,

guer, La Condamine, Clairault, and Maupertuis died; and it was only when astronomical instruments became more perfect, that the fact of the flattening at the poles could be accurately ascertained. The Academy gave still more importance to these researches by proposing to take the measurement of the earth as the fundamental element of a system of general and uniform measures, of which all the parts would be connected by simple relations, and in accordance with our mode of numeration. The Academy hopes that such a system, founded upon natural elements, invariable and independent of the prejudices of the people, will ultimately become as common to all, as are now the Arabian ciphers, the division of time, and the calendar. This wish was long ago expressed by the best and the most enlightened of our kings. The proposal for carrying it into effect was one of the last sighs of the Academy, and the act which decided its execution was one of the last which preceded the fatal epoch of our great political convulsions. All the institutions tending to maintain civilization and knowledge perished, and the Academy perished with them. But men of science prosecute without authority what they esteem useful. In the midst of the disorders of popular anarchy, MM. Delambre and Mechain, furnished with the new instruments of Borda, commenced and prosecuted, often at the risk of their lives, the most extensive and exact measurement of the earth. They concluded it with the same perfection, though not with the same ease, as if it had been in times of the most profound tranquillity. Nor was the measurement of the pendulum neglected. Borda, who had so far advanced every other mode of observation, invented for this experiment a method, the exactness of which surpassed every thing previously known, and which has never been surpassed.

After these operations, it was thought that the arc might be continued many degrees south across Catalonia, and that it might be possible to prolong it to the Balearic isles by means of an immense triangle, of which the sides extending over the sea should join these islands to the coast of Valentia. Mechain devoted himself to this operation: but after having surveyed all the chain and measured the first triangles, he died of a fever in Valentia. M. Arago and myself were intrusted with the completion of the work, along with the commissioners of the king of Spain. We had the good fortune to succeed; but, as is well known, M. Arago did not return to France without encountering great danger, and after a distressing captivity. Our results confirmed those of the arc of France, and gave them a new proof of accuracy. After the method of Borda, we also measured at our remote station the lengths of the seconds pendulum. M. Matthieu and myself

repeated

repeated the same operations upon different points of the arc comprised between Perpignan and Dunkirk. These experiments gave for the flattening of the earth a value almost equal to that which M. Delambre had already obtained, by comparing the arc of France and Spain with the degrees of the equator, but calculated with more accuracy, and corrected by the degree of Lapland, which Mr. Svanberg, an able Swedish astronomer, had certified by new observations; and finally, with an arc of many degrees which Major Lambton had measured with great accuracy in the British possessions of India.

Confirmed by so many combinations, our arc of France and Spain had a good title to become a fundamental model for measures. An occasion occurred of rendering it still more important. Since the rebellion of 1745, the English government had perceived the utility of constructing a detailed map of the three kingdoms, which should equally serve to direct the amelioration of the country in peace and its defence in war. I may state, in passing, that it is the war for twenty years back which has given to geodesiacal operations the great extension and the extreme perfection which they have acquired in all the states of Europe. However this may be, the English *triangulation* begun by General Roy, and continued after him by Colonel Mudge, was prolonged from the south of England to the north of Scotland, and presented in that extent many degrees of the terrestrial meridian measured with excellent instruments. It was desirous that this arc should be joined to that of France. But as from the geographical position of England she is placed a little to the westward of ours, there was reason to fear, lest, all the terrestrial meridians not being exactly alike, the difference of longitude would affect the results which might be obtained from that junction. Nevertheless, there could be no dread of this, so far as concerned the measurements of the pendulum, which are much less disturbed than the degrees by the slight irregularities of the figure of the earth. The Board of Longitude was desirous that the same apparatus which had served for these measurements in France and Spain, should be employed through the whole extent of the English arc. The consent of government and the approbation of men of science in England were necessary. Neither the one nor the other was wanting. The respectable Sir Joseph Banks and his worthy friend Sir Charles Blagden assured us of all imaginable facilities. M. Lainé the minister of the interior, with whom every thing useful or honourable has only possibility for its limits, was able to furnish means for this enterprise, and the Board of Longitude had the goodness to intrust me with its execution.

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I left Paris in the beginning of May last year, carrying with me the apparatus made use of in other points of the meridian: a repeating circle by M. Fortin, an astronomical clock and chronometers by M. Breguet;—in fine, every thing necessary for the observations. Orders from the English government, obtained through the vigilant intervention of Sir Joseph Banks, awaited our arrival at Dover. The whole was sent to me quite entire, under the seal of the Customs, without fees, without inspection, as if I had not passed from one country into another. Every thing was protected with the same care in the carriage to London, and was at last deposited in the house of Sir Joseph Banks. How can I describe what I felt for the first time on seeing the venerable companion of Cook, rendered illustrious by his long voyages, remarkable for a stretch of mind and an elevation of feeling which interest him in the progress of every species of human knowledge! Possessing high rank, an independent fortune, and universal respect, Sir Joseph has rendered all these advantages the patrimony of the learned of all nations. So simple, so easy in his kindness, it almost seems as if he felt the obligation were on his part; and at the same time he is so good that he leaves us all the pleasure of gratitude. What a noble example of a protection, whose sole authority is founded in esteem, respect, free and voluntary confidence; whose titles consist only in an inexhaustible good will, and in the recollection of services rendered; and the long and uncontested possession of which necessarily supposes rare virtues and an exquisite delicacy, more especially when we recollect that all this power is formed, maintained and exercised among equals!

Favoured by these honourable auspices, every thing became easy. Colonel Mudge, who had shown himself most favourably disposed towards our enterprise, seconded it by every means in his power. We left Edinburgh together, and fixed our first station in the Fort of Leith, where Colonel Elphinston, the commandant, afforded us all the accommodation in his power. I required a situation where the view was open, and also sheltered, to erect my circle. I constructed a portable observatory which could be taken down at pleasure, so as to allow me to make observations on all the sides of the horizon. It was necessary, however, that the apparatus of the pendulum should be fixed with solidity; and for this purpose stones of the weight of sixty quintals were fixed in thick walls with iron chains. Every thing that could be useful was lavished upon me, and if my observations were incorrect it was my own fault. Unfortunately the health of Colonel Mudge did not permit him to accompany me; but his place was supplied by one of his sons, Captain Richard Mudge, with whom I completed my labours. After they were

finished

finished at the Fort it was necessary to go and repeat them in the Orkneys, the uttermost limit of the English arc. But Col. Mudge perceived that it was possible to connect the Orkneys with the Shetland isles, by triangles whose *apices* should rest upon the isles, or rather upon the intermediate rocks, of Faro and Foula. This plan extended the new arc two degrees to the north, and this was sufficient to decide the matter. The arrangement had still another advantage, of very different importance, which consisted in carrying the English line of operation two degrees towards the east, almost upon the meridian of Formentera. By this fortunate change the English operation became the prolongation of ours, and the two together form an arc almost equal to the fourth part of the distance from the pole to the equator. If one might hope that the different nations of Europe would agree to choose the base of a common system of measures in nature, is there not here an element the most beautiful and the most certain that could be adopted? And this arc, which leaving the Balearic isles, traverses Spain, France, England, Scotland, and stops at the rocks of the ancient Thule, being taken in combination with the flattening of the earth, which is deduced from the measurement of the pendulum, or from the theory of the moon,—will it not give for fundamental unity, a measure the most complete, and I dare say the most European that can ever be expected?

When the possibility of this great project was conceived, it absorbed all our thoughts: but the delicate health of Colonel Mudge did not permit him to realize these hopes in person, and he intrusted the execution to one of his officers. He gave me his son, whose assistance had been of such service, and which might still be of much more. My apparatus, the portable observatory, the large stones and the iron chains were all embarked, with the instruments of the English operation, in the Investigator brig-of-war, commanded by Captain George Thomas, whose activity and skill do not certainly stand in need of any praise of mine, but whose politeness demands all my gratitude. This officer was so good as to take me on board his ship to Aberdeen, where, during a short stay, I experienced the most distinguished hospitality. On the 9th of July we sailed for Shetland. We were long at sea, and bitterly regretted the loss of so many fine nights for observations. Leaving the Orkney mountains upon our left, on the sixth day we discovered the Isle of Faro, which saw the vessel of the Invincible Armada broken to pieces upon her rocks. The peaks of Shetland appeared, and on the 18th of July we landed near the southern point of the isles, where the Atlantic billows uniting with those which come from the sea of Norway, cause a continual swell and a perpetual tempest.

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The desolate aspect of the island corresponded with the soil and climate. It was no longer those fortunate isles of Spain, those smiling countries, Valentia, that garden where the orange and the lemon trees in flower shed their perfumes around the tomb of a Scipio, or over the majestic ruins of the ancient Saguntum. Here, on landing upon the rocks fissured by the waves, the eye sees nothing but a soil wet, desert, and covered with stones and moss, and cragged mountains scarred by the inclemency of the heavens; not a tree nor shrub nor bush to soften the savage aspect: here and there some scattered huts, whose roofs covered with thatch allowed the thick smoke with which they are filled to escape into the fog. Reflecting on the sadness of this abode, where we were about to remain in exile during many months, we took a direction across pathless plains and hills towards the small assemblage of small stone houses forming the capital called Lerwick. There we felt that the social virtues of a country were not to be estimated by the appearance of poverty or riches. It is impossible to conceive hospitality more free, more cordial, than that with which we were received. People who but a little before were ignorant of our names, were eager to conduct us every where. Informed of the design of our visit, they collected and communicated every sort of useful information. In particular Dr. Edmonston, a well-informed physician, who has published a Description of the Shetland Islands, gave us a letter to his brother, who resides in the isle of Unst, which afforded us a station about half a degree north of Lerwick, where we resolved to make our experiments. But arrived at Unst, we were constrained, from the local situation of the island, to transfer ourselves to a small island called Balla, at the entrance of the principal bay of Unst, where we disembarked our instruments. But upon a more close examination of this station, its exposure to the winds, the moisture which prevailed in abundance, the remoteness from every habitation, and the many difficulties which presented themselves to an establishment suited to the pendulum—made us resolve to return to Unst, and to ask a reception in the only house which was in sight, which happened very luckily to be that of Dr. Edmonston's brother. A large sheepfold (empty because it was now summer) whose walls were capable of resisting every storm, received the apparatus of the pendulum. The portable observatory together with the repeating circle were placed in the garden. With great labour we dragged the stones to the place of their destination. It required all the efforts of the brig's crew, guided and animated by their officers. On the 2d of August we commenced our observations, and on the 10th made the first experiment with the pendulum. On the 17th we had made eight of these experiments, and 270 observations

observations of the latitude. I was now certain of success, and perseverance was only necessary. It was no small disadvantage that Captain Mudge became greatly indisposed; and a whaler having touched at the island, I with difficulty prevailed upon him to return to a more genial climate. He invested me with all the powers of his father, and afforded all necessary assistance. When left alone, I found the advantage of residing with Mr. Edmonston. His kindness increased with my difficulties. The operation of the repeating circle required two persons, one to follow the star and another to mark the indications of the level. A young carpenter, who by his fitting up the observatory had given proof of his intelligence, (and who, similar to the generality of the peasants in Scotland, could read, write, and cipher,) was by the advice of Mr. Edmonston employed for the latter part of the observation. He acquitted himself better than a more learned assistant; for he observed and marked my level with the fidelity and the accuracy of a mechanic, and even to satisfy my impatience would not admit my results until the bubble of the level was in a state of perfect immobility. With this assistant, in two months I collected 38 series of the pendulum, each of five or six hours, 1400 observations of the latitude in 55 series made equally on the south and the north of the zenith, and, to regulate my clock, about 1200 observations of the absolute heights of the sun and stars. After this I was chiefly employed in observing, and only made three or four calculations; but the remainder since my return home I have found accurate. The results which are deduced from them, being combined with those of Formentera of the arc of France, give for the flattening of the earth exactly the same value which is deduced from the theory of the moon, and the measurement of the degrees compared at great distances. This perfect agreement between determinations so different, shows at once the certainty of the result, and the sure method which science employs to obtain it. Nor was this point of precision reached without great difficulty, as is obvious from the fact—that the variation of the length of the pendulum by which the flattening is measured, is in all, from the equator to the pole, but four "millimetres," less than two lines, and from Formentera to Unst, one "millimetre and a half," or less than three-fourths of a line. This small portion, however, exhibits and measures even with great accuracy the flattening of the whole terrestrial spheroid, and proves that in spite of slight accidents of composition and arrangement, which this exterior and slender surface presents, the interior of the mass is composed of strata perfectly regular, and subjected to the laws of superposition, density and form, which a primitive state of fluidity had assigned to them.

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But however great the pleasure of having completed my operations, if I had immediately departed from the rocks of Balta to my own country, my sentiments would have been specifically different concerning these isles. The dreariness of their situation, the poverty of their soil, and the inclemency of their sky, would have accompanied me, and I should have remained ignorant that they contain sensible, kind, virtuous, and enlightened inhabitants. Nor should I have been able to discover the charm which these pathless barren regions—the region of rain, of tempest, and of sterility—have to reconcile them to such hardships.

Peace and not plenty constitutes this charm. The sound of a drum has not been heard in Unst for twenty-five years, while Europe was wasting her best blood; and during all that period the door of the house where I resided had not been shut day or night. Neither conscription nor press-gang had afflicted the inhabitants of these peaceful isles. Their rough seas protect them from the incursions of privateers, and their poverty is still a stronger defence. These people receive the intelligence of the transactions of the continent, as they would read the history of other times. Their calm and contracted situation gives to their mode of life a charm unknown in other climes. They live in one great family. But the strength of affection produces the extreme of grief upon death or separation. When death enters the dwellings of those whose affections are so concentrated, it comes in all its bitterness. Nor are the grief and sorrow much less when a son, or a brother, or a friend takes his journey to another country, for seldom does their own little isle contain the children with the fathers. A small portion around their huts is all the soil that is cultivated; and horses and sheep almost in a wild state pasture the remainder. A principal part of their wealth and support is procured from the tremendous waves and billows of the ocean, which with unexampled boldness they combat in quest of fish. When the weather is good the toil becomes a pleasure; but when the sea becomes tempestuous, the struggle in their uncovered boats is violent. Under their guidance I have found myself calm when contemplating those lofty cliffs of primitive rocks—that ancient structure of the globe, whose strata lie inclined towards the sea, and, undermined at their base by the fury of the waves, seem threatening to bury under their ruins the frail bark which bounds at their feet.

Carrying with me the most agreeable recollections, I took leave of these isles after a residence of two months. An equinoctial gale conveyed us in fifty hours to Edinburgh. Returned to Colonel Elphinston, I experienced that hospitality had not retired to the Shetland isles. Having finished my particular

labours, an opportunity was afforded to consider the situation of the country; the character, the manners, the institutions, and the pursuits of the inhabitants. The review was both consoling and sorrowful, to one whose days had been spent amid wars and commotions. Here dwelt a people poor, but laborious; free, but submissive to the laws; moral and religious, without sternness or indifference. The peasants were seen reading the Essays of Addison, Pope, Johnson, Chesterfield, and the most approved of the English moralists. Even in the passage-boats cards and dice were exhibited. Village farmers were seen in clubs discussing the topics of politics and of agriculture; and these formed into societies to purchase the most entertaining and instructive works, the *Encyclopædia Britannica* not excepted. I saw, in fine, the higher classes adorning in an eminent degree their stations, by exciting and directing all the enterprises of public utility, mingling with the vulgar, but preserving a noble superiority, procuring respect without exciting envy, and enjoying as the reward of their exertions, peace, union, reciprocal esteem, mutual confidence, and a lively affection.

I next visited the most industrious counties of industrious England. I saw there the powers of nature employed in the service of man under every supposable shape, and man himself reserved for those operations which mind alone can direct and perform; but I rather admired that immense display of manufactures, than wished to see them established in my own country. After visiting Oxford and Cambridge, those ancient abodes of learning, I went to rejoin M. Arago in London, to measure the seconds of the pendulum no longer in a desert, but in the magnificent Observatory at Greenwich. M. Humboldt attended him, assisted in the operation, and meanwhile seemed to forget the multitude of his other talents in his labours as an excellent astronomer. The Astronomer Royal manifested that generous ardour which men devoted to the progress of science, alone can feel.

After such success, and brought under so many pleasing obligations, I returned to my native country. The pleasure of observing the heavens, of studying one of the greatest phænomena of nature with fine instruments, by so many observations, and in a place renowned for so many astronomical discoveries, enabled me to confer a lasting tribute of gratitude upon the place of my birth. In a voyage undertaken for the advancement of science, the stranger learns what to honour and what to cherish. Without the circle of political passions, without rank, without ambition, his principal aim is to do good to mankind. He is ennobled by the numerous services which he has rendered to the civilization of the world, by the universal admiration which he has excited, and by those intellectual stores with which he has

enriched

enriched the arts and sciences. Similar to Minerva, that country accompanies him into a foreign land; she speaks for him, introduces him, protects him, and claims in his favour an hospitality which she has often nobly conferred. Having reached the end of his labours, and while relating to his countrymen the reception, the assistance, the kindness, the friendship received from a celebrated nation, he experiences in the expression of his gratitude a pleasure so much the more pure, that he feels sensible that all these favours were less conferred on himself, than through him on his country.

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## XX. *On the Means of curing the Dry-Rot.* *By* A Correspondent.

*To Mr. Tilloch.*

Sir, — Observing in the public papers and periodical works the havoc the dry-rot has made in our shipping and public and private buildings, and having, I presume, found out substances for the preservation of wood from dry-rot; I take the liberty of stating the composition and mode of applying them.

First. Make a strong caustic solution in water of barilla, kelp, or potash, and when boiling hot, wash the parts of the wood affected with the rot. The effect of this caustic ley will be the destruction of the vegetating fibres of the fungus.

Secondly. Dissolve oxide of lead or iron in pyrolignous acid; and twelve hours after the first application of the leys soak the wood well with this solution. A decomposition of the metallic liquor takes place; the acid and alkali unite, and the oxide of the lead or iron is precipitated in the pores of the wood, and, prevents the fungus from spreading.

Another way of preventing the rot is: first, to wash the wood with the pyrolignous solution of lead, and ten or twelve hours after to wash it with a strong solution of alum (in the proportion of one pound and a half of alum to one gallon of water).

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Since writing the above, I have seen in your Philosophical Magazine an Essay by Mr. Gavin Inglis, recommending sulphate of iron to prevent the dry-rot. I think you will find the iron liquor in my process preferable, as the alkaline solution precipitates the oxide of the metal in the pores of the wood. I have paling now in good preservation, that was put up fourteen years ago, with staves of old iron liquor pipes and puncheons, and never painted. The wood is hard, and can scarcely be cut with a knife; the liquor has penetrated into the pores of the wood, and contracted or filled them up.